UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/547,844	09/02/2005	Satoshi Sugahara	125209	2196

25944 7590 12/04/2006

OLIFF & BERRIDGE, PLC
P.O. BOX 19928
ALEXANDRIA, VA 22320

EXAMINER	
SANDVIK, BENJAMIN P	
ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 12/04/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/547,844	SUGAHARA ET AL.	
	Examiner	Art Unit	
	Ben P. Sandvik	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-86* is/are pending in the application.

4a) Of the above claim(s) *18-39,42-59,61,66,69-71 and 79-81* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,16,17,40,41,60-68,72-78 and 82-86* is/are rejected.

7)☒ Claim(s) *4-15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election with traverse of Species 1 in the reply filed on 8/29/2006 is acknowledged. The traversal is on the ground(s) that search and examination of the entire application could be made without serious burden. This is not found persuasive because the species are classified in different subclasses, hence the examination species 2 (classified in class 257 subclass E27.104) would require further search and consideration by the examiner.

The requirement is still deemed proper and is therefore made FINAL

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 16, 17, 40, 60, 62-65, 67, 68, and 82-86 are rejected under 35 U.S.C. 102(b) as being anticipated by Johnson (U.S. Patent #5654566).

With respect to **claim 1**, Johnson teaches a transistor (Fig. 4, 100) comprising: a ferromagnetic source that is formed with a ferromagnetic body from which spin-polarized conduction carriers are injected (Fig. 4, 110 and Col 10 Ln 14-16); a ferromagnetic drain that is formed with a ferromagnetic body that receives the spin-polarized conduction carriers injected from the ferromagnetic

source (Fig. 4, 116 and Col 10 Ln 17-18); a semiconductor layer that is provided between the ferromagnetic source and the ferromagnetic drain, and forms a Schottky junction having a Schottky barrier at each junction interface with the ferromagnetic source and the ferromagnetic drain (Schottky junction exists between metal and semiconductor); and a gate electrode that is formed associated with the semiconductor layer (Fig. 4, 122).

With respect to **claim 2**, Johnson teaches that the relative magnetization is parallel or antiparallel (Col 10 Ln 19-21).

With respect to **claim 3**, Johnson teaches that the source and drain are made of ferromagnetic metal (Col 12 Ln 14-15).

With respect to **claim 16**, Johnson teaches that the trans-conductance can be controlled in accordance with relative magnetization direction of the ferromagnetic drain with respect to the ferromagnetic source, with the same bias being applied (Col 10 Ln 19-21).

With respect to **claim 17**, Johnson teaches that when the ferromagnetic source and the ferromagnetic drain exhibit parallel magnetization, the transistor has a threshold voltage that is defined as a gate voltage for generating a predetermined current between the ferromagnetic source and the ferromagnetic drain, with a voltage being applied to the gate electrode, the transistor being of the accumulation channel type or the inversion channel type (Col 9 Ln 17, "gate voltage").

With respect to **claim 40**, Johnson teaches that the source and drain are formed by deposition (Col 12 Ln 17).

With respect to **claim 60**, Johnson teaches that the semiconductor layer is an undoped semiconductor or an intrinsic semiconductor (Fig. 4, channel 112 is not doped).

With respect to **claim 62**, Johnson teaches that the semiconductor layer is an undoped semiconductor or an intrinsic semiconductor, the transistor being of the accumulation channel type (Col 9 Ln 66-67, holes transported in p-type semiconductor layer).

With respect to **claim 63**, Johnson teaches that the semiconductor layer is an undoped semiconductor or an intrinsic semiconductor, the transistor being of the inversion channel type (Col 9 Ln 66-67, electrons transported in p-type semiconductor layer).

With respect to **claim 64**, Johnson teaches that the channel length is equal to or shorter than the mean free path associated with carrier energy relaxation (Col 9 Ln 38-40).

With respect to **claim 65**, Johnson teaches a metal layer (Col 12 Ln 15, FeCo).

With respect to **claim 67**, Johnson teaches that when the relative magnetization of the ferromagnetic drain with respect to the ferromagnetic source is antiparallel, the drain current is lower than the drain current in a case of parallel magnetization (Col 10 Ln 19-21).

With respect to **claim 68**, Johnson teaches that the trans-conductance can be controlled in accordance with relative magnetization direction of the ferromagnetic drain with respect to the ferromagnetic source (Col 10 Ln 19-21).

With respect to **claim 82**, Johnson teaches a transistor comprising a ferromagnetic source that is formed with a ferromagnetic body from which spin-polarized conduction carriers (Fig. 4, 110); a ferromagnetic drain that is formed with a ferromagnetic body and receives the spin-polarized conduction carriers injected from the ferromagnetic source (Fig. 4, 116); a semiconductor layer that is provided between the ferromagnetic source and the ferromagnetic drain, and form junctions with the ferromagnetic source and the ferromagnetic drain (Fig. 4, 112); and a gate electrode that is formed associated with the semiconductor layer (Fig. 4, 122).

With respect to **claim 83**, Johnson teaches a gate insulating film formed between the gate electrode and the semiconductor that is formed through oxidation or deposition (Col 11 Ln 57).

With respect to **claim 84**, Johnson teaches that the gate insulating film contains a high dielectric constant material (silicon dioxide).

With respect to **claim 85**, Johnson teaches that the transistor is a MISFET (Col 11 Ln 57).

With respect to **claim 86**, Johnson teaches a transistor that functions as a depletion-mode transistor (Col 16 Ln 3).

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 72 and 73 are rejected under 35 U.S.C. 102(e) as being anticipated by Ohno et al (U.S. PG Pub #2001/0031547).

With respect to **claim 72**, Ohno teaches a transistor comprising a source and drain that are of a first conduction type (Fig. 5, 53, 54, 56, 57), and are formed with ferromagnetic semiconductors (Paragraph 28); a semiconductor layer that is provided associated with the source and the drain (Fig. 5, 52), and has a channel of first conduction type formed therein (formed upon the generation of spin-polarized conduction electrons); and a gate electrode that is formed as opposed to the semiconductor layer (Fig. 5, 55).

With respect to **claim 73**, Ohno teaches that the semiconductor layer is formed with an undoped semiconductor or an intrinsic semiconductor (Paragraph 28, GaSb).

Claims 75, 77, and 78 are rejected under 35 U.S.C. 102(e) as being anticipated by Hsu et al (U.S. Patent #6753562).

With respect to **claim 75**, Hsu teaches a source that is formed with a first pn junction (Fig. 3a, 102) between a first ferromagnetic semiconductor and a semiconductor layer that are of different conductive types from each other (Fig.

3a, 101 and Col 9 Ln 58-63); a drain that is formed with a second pn junction (Fig. 3a, 103) between a second ferromagnetic semiconductor and the semiconductor layer that are of different conductive types from each other; and a gate electrode that is formed associated with the semiconductor layer (Fig. 3a, 104).

With respect to **claim 77**, Hsu teaches that when the relative magnetization of the ferromagnetic drain with respect to the ferromagnetic source is antiparallel magnetization, the drain current is lower than the drain current in a case of parallel magnetization (Col 9 Ln 3-8).

With respect to **claim 78**, Hsu teaches that the trans-conductance can be controlled in accordance with the relative magnetization direction of the ferromagnetic drain with respect to the ferromagnetic source (Col 9 Ln 3-8).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Johnson, in view of Ohno.

With respect to **claim 41**, Johnson does not teach that the ferromagnetic source and drain are formed by introducing magnetic elements into the

semiconductor layer. Ohno teaches ferromagnetic source and drain that are formed by introducing magnetic elements into the semiconductor layer (Paragraph 22, GaMnSb). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the source and drain as taught by Ohno in order to create a Type II heterojunction in the device.

Claim 74 rejected under 35 U.S.C. 103(a) as being unpatentable over Ohno, in view of Johnson.

With respect to **claim 74**, Ohno does not teach that the channel length is equal to or shorter than the mean free path associated with carrier energy relaxation. Johnson teaches that the channel length is equal to or shorter than the mean free path associated with carrier energy relaxation (Col 10 Ln 60-63). It would have been obvious to one of ordinary skill in the art at the time the invention was made to arrange the channel length as taught by Johnson in order to control the resistance between the source and drain.

Claim 76 rejected under 35 U.S.C. 103(a) as being unpatentable over Hsu, in view of Johnson.

With respect to **claim 76**, Hsu does not teach that the channel length is equal to or shorter than the mean free path associated with carrier energy relaxation. Johnson teaches that the channel length is equal to or shorter than the mean free path associated with carrier energy relaxation (Col 10 Ln 60-63). It would have been obvious to one of ordinary skill in the art at the time the

invention was made to arrange the channel length as taught by Johnson in order to control the resistance between the source and drain.

Allowable Subject Matter

Claims 4-15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben P. Sandvik whose telephone number is (571) 272-8446. The examiner can normally be reached on Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

bps

EVAN PERT
PRIMARY EXAMINER